



# Project Summary

US Army Engineer  
Research and Development Center  
Waterways Experiment Station

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## Geophysical Methods for Site Characterization and Measurement of In Situ Properties

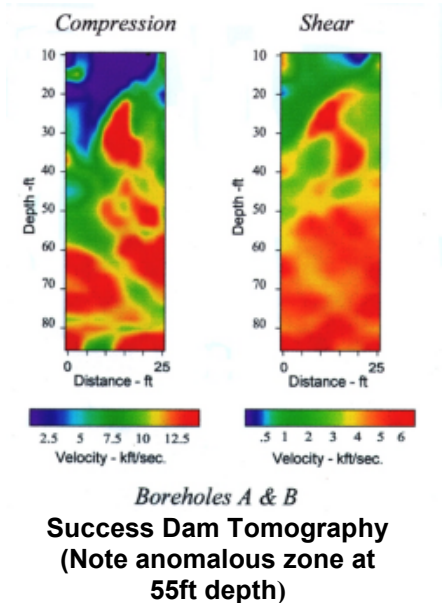
**Point of Contact:** Mr. Robert F. Ballard, Jr., at 601-634-2201, or e-mail:  
[Robert.F.Ballard@erdc.usace.army.mil](mailto:Robert.F.Ballard@erdc.usace.army.mil)

**Research Team:** Robert Ballard, José Llopis, Rodney Leist, Richard Rechten (contractor), and Richard McGee (contractor)

**Purpose:** Develop a seismic/acoustic impedance procedure to identify and characterize large volumes of soil materials relative to their susceptibility for liquefaction.

### Status (Prior Years):

Field sites were chosen and prioritized as the result of an interdisciplinary workshop conducted at WES in January 1996. Geophysical tests were successfully completed at Success Dam, CA, during the summer of 1996. Further development of new methods occurred at Conconully and Salmon Lake Dams, WA (BuRec dams) in May-June 1997. Areal site coverage was extended from 15 ft between boreholes to 215 ft by combining vertical seismic profiling and crosshole tomographic techniques. Waterborne acoustic impedance and site attenuation tests were performed at Arkabutla Reservoir during March 1999 are reported in ERDC/GL Technical Report TR-00-5, "Biot-Based Geoacoustic Investigation of Lake Arkabutla, MS" by Richard G. McGee, Robert F. Ballard, Jr., and Rodney L. Leist (August 2000).



Conconully Dam, WA

**Current Accomplishments:**

- Definition of an appropriate physical model of surficial earth materials useful for the extraction of velocity and density profiles from VSP-type (surface sources and borehole receivers) seismic data.
- Inversion process for simultaneous determination of minimum-time, seismic-wave, ray-paths from multi-ple-offset source positions on ground surface to multiple-depth receiver positions in multiple boreholes.
- Inversion process for extraction of a unique velocity depth-profile from seismic data (either compression or shear) that predicts minimum travel-times, for all multiple source-receiver pairs, that differ from measured travel-times by an acceptable statistical error.
- Inversion process for extraction of a unique density depth-profile from seismic data that predicts first-arrival amplitudes, for all multiple source-receiver pairs, that differ from measured first-arrival amplitudes by an acceptable statistical error.
- Field procedures for acquisition of seismic data appropriate for inversion processes. Procedures for production of additional depth-profiles for:

Young's Modulus	Shear Impedance
Shear Modulus	Overburden Pressure
Bulk Modulus	Porosity for Unconsolidated Sediments
Poisson's Ratio	Compression Impedance

**Items to be completed:**

- Final dry land geophysical procedure verification at a well-documented test site near Sikeston, Missouri. Tests are scheduled for completion during the latter part of May 2001.
- Production of a user-friendly, CD-ROM-based, data processing package that will guide the user from initial translation of recorded data in SEG format to final depth-profile graphs of material properties. (To be included as a part of the final report which will also detail appropriate data acquisition procedures and inversion procedures applied to Salmon Lake and Conconully reservoir).
- Waterborne seismic attenuation test procedure verification at Grenada Reservoir. (Note that this will not be accomplished unless the project continues through FY 02.)